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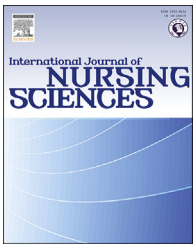

Original Article

Reliability and validity of the Chinese version of the PedsQL Multidimensional Fatigue Scale in children with acute leukemia

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ABSTRACT

Background: The **PedsQL Multidimensional Fatigue Scale** (PedsQL™ MFS) is widely used to rate fatigue in children living in English-speaking countries. However, insufficient instruments are available to conduct parallel assessment on fatigue in parents and children in China. In this regard, an appropriate measurement method must be developed.

Objectives: This study aims to determine the reliability and validity of the Chinese-language PedsQL™ MFS.

Methods: Children with cancer ($n = 125$) and their parents were surveyed in Guangzhou, China. The parents of children aged 2–4 years completed the PedsQL™ MFS proxy reports, whereas the other children and their parents completed the questionnaires by themselves.

Results: The PedsQL™ MFS-Chinese version demonstrated satisfactory internal consistency reliability (child self-report Cronbach's $\alpha = 0.87$; parent self-report Cronbach's $\alpha = 0.93$). The factor loadings of the items ranged from 0.78 to 0.87 for general fatigue, 0.56–0.78 for sleep/rest fatigue, and 0.62–0.89 for cognitive fatigue.

Conclusion: This study proves that the PedsQL™ MFS-Chinese version is an effective tool for screening fatigue in Chinese children with cancer.

1. Background

Acute leukemia is a type of cancer most common among children. The development of medicine has rendered this disease curable and has increased the survival rates of patients. However, the incidence rate and treatment-related side effects (e.g., fatigue, pain, nausea, vomiting, and nutritional concerns) of leukemia have significantly increased [1,2].

Fatigue is the most common and distressing side effect during cancer treatment and has a profound influence on the activities of daily life of patients [3,4]. Up to 60–99% of cancer patients reported fatigue [3]. The National Comprehensive Cancer Network has defined fatigue as "a persistent,

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subjective sense of tiredness related to cancer or cancer treatment that interferes with usual functioning" [5].

Scholars have given much attention to fatigue in children with cancer since the 1990s. Hockenberry-Eaton et al. [6] first evaluated fatigue as a symptom in children with cancer and provided the theoretical foundation for developing its conceptual model. Subsequent studies indicated that fatigue may influence children with cancer in different aspects, including both physical and psychosocial functioning. Fatigue also occurs in different phases of the treatment, such as during, at the end stage, or even after its completion [7,8].

Although most children with cancer are chronically fatigued, this phenomenon has not been given sufficient attention in China; one explanation could be that health professionals always place a high value on other cancer-related symptoms, such as nausea, vomiting, pain, and hair loss. Furthermore, children assumed that parents or healthcare providers could not help them and that fatigue is only a normal part of the disease progression. Some older children would rather manage fatigue by themselves than place a large burden on their parents [1,9]. Another explanation for this phenomenon is the absence of any uniform and well-developed Chinese instrument. A barrier exists in the clinical investigation of fatigue and in the clinical management of pediatric oncology patients in China. Hence, a reliable and valid instrument to measure fatigue in children with cancer and provide basic evidence for further research is needed.

There were not enough instruments that can measure the fatigue experienced by both parent and affected child in China are insufficient. Therefore, we aim to establish an appropriate measurement to evaluate fatigue.

The PedsQL™ Multidimensional Fatigue Scale (PedsQL™ MFS) is commonly used to assess fatigue in pediatric patients. This instrument was developed by Varni on the basis of the concept that disease-specific symptoms are causal indicators of generic health-related quality of life (HRQOL). PedsQL™ MFS was designed as a generic symptom-specific instrument to measure fatigue in pediatric patients aged 2–18 years from the perspective of the children, adolescents, and their parents [10].

The present study aims to evaluate the reliability and validity of the Chinese version of PedsQL™ MFS. We translated the PedsQL™ MFS and evaluated the psychometric properties in hospital-based clinical groups.

2. Materials and methods

2.1. Subjects

A cross-sectional descriptive study was employed. A total of 125 children with acute leukemia and their parents from the top three hospitals in Guangzhou were recruited through convenient sampling. Only children who had been diagnosed to have acute leukemia for 1 month at the least were included. Children who had developmental disorders or known psychiatric, neuromuscular, or other chronic diseases were excluded.

2.2. Measures

2.2.1. PedsQL™ MFS (Chinese version)

The PedsQL™ MFS developed by Dr. J.W. Varni comprises parallel child self-reports and parent proxy reports. Child self-reports were designed for children aged 5–7 (young child), 8–12 (child), and 13–18 years (adolescent). Parent proxy reports for children also include 2–4 years of age (toddler), and they are used to assess the parent's perception of their child's fatigue [11].

The instrument consists of 18 items and is divided into three subscales: (1) general fatigue (GF, six items, e.g., "I feel tired;" "I feel too tired to do things that I like to do"); (2) sleep/rest fatigue (SRF, six items, e.g., "I feel tired when I wake up in the morning;" "I rest a lot"); and (3) cognitive fatigue (CF, six items, e.g., "It is hard for me to keep my attention on things;" "It is hard for me to think quickly"). The participants were assessed on how often a particular problem occurred in the past month by using a five-point Likert scale from 0 to 4 (0 = never, 1 = almost never, 2 = sometimes, 3 = often, and 4 = almost always). Each item was reverse-scored and rescaled to 0–100 scale. Hence, a 4 in the Likert scale was transformed into a score of 0, and a 0 in the Likert scale was transformed into a score of 100; in short, higher scores indicate fewer symptoms of fatigue [12].

2.2.2. Translation/back-translation of the PedsQL™ MFS to Chinese version

The Chinese version was developed in the following phases in accordance with the suggested guidelines [13]. We contacted Dr. J.W. Varni, and he had authorized us to use and translate the PedsQL™ MFS into Chinese.

(1) Forward translation (English–Chinese translation): Two bilingual translators whose mother language is Chinese and who are knowledgeable about pediatric nursing translated the original instrument to Chinese independently. Subsequently, a third independent Chinese translator compared the forward-translated versions, resolved ambiguities and discrepancies, and generated the initial translated version.
(2) Back translation (Chinese–English translation): The initial translated version was translated back into English by another two bilingual translators whose mother language is English independently. A committee consisting of five translators and two nursing experts compared the back-translated version with the original instrument, and they also revised the contradictory items.
(3) Pretest and cross-cultural adaptation: A total of 20 children and their parents whose language is Chinese were chosen to complete the Chinese version instrument; afterward, we adapted the ambiguities. Finally, we sent the final Chinese version to Dr. J.W. Varni.

2.3. Procedure

Each parent received a written document, including the Chinese versions of the PedsQL™ MFS and the PedsQL 3.0 Cancer Module, and all participants received oral and written explanations of the study. Researchers explained our procedure for

the confidentiality and safety of the investigation; we also reminded the participants that they volunteered in this study. For children aged 2–4 years, only proxy reports were filled out by their parents. Children aged 5–7 years received researchers' assistance to finish the questionnaires. Children aged 8–14 years and all parents finished the questionnaires independently.

2.4. Psychometric testing and statistical analysis

SPSS 17.0 and Amos 17.0 for Windows were used to conduct all the statistical analyses in our study.

2.4.1. Feasibility and reliability

The feasibility of the Chinese version of the PedsQL™ MFS was examined by the percentage of missing values for each item. The Cronbach's alpha coefficient was used to determine the internal consistency of the instrument, and it was considered an acceptable reliability for a new instrument if the Cronbach's alpha coefficient was higher than 0.7.

2.4.2. Content validity

We invited a panel comprising three Chinese clinical pediatrics experts and three pediatric oncologists in the nursing school of Sun Yat-sen University in China to assess the content validity index (CVI) of the Chinese version of the PedsQL™ MFS. Subsequently, the instrument was distributed to the participants. The CVI reflects the extent of each item, and the whole instrument represents what they are expected to measure. To rate the CVI of the instrument, we used a four-point scale from 1 to 4. The CVI was accepted if the Item-CVI and Scale-CVI were higher than 0.78 and 0.8, respectively.

2.4.3. Construct validity

The factor structure of the PedsQL™ MFS (Chinese version) was evaluated using confirmatory factor analysis (CFA) to check whether or not the translated instrument had the same factor solution with the original instrument. When the number of child self-reports was less than 100, we only checked the construct validity of the parent proxy report by CFA. The chi-squared test (χ^2), goodness-of-fit index (GFI), comparative-fit index (CFI), normed-fit index (NFI), adjusted goodness-of-fit index (AGFI), and root mean squared error of approximation (RMSEA) were used. The model was expected if the value of χ^2 divided by the degrees of freedom (χ^2/df) was below 3.0; the values of GFI, CFI, NFI, and AGFI were more than 0.9; and the RMSEA was less than 0.1.

Construct validity was further examined by using exploratory factor analysis (EFA) to test the underlying dimensions of the PedsQL™ MFS. Factors were extracted through the principal component analysis with varimax rotation.

2.4.4. Criterion-related validity

Criterion-related validity was evaluated by analyzing the correlations between the Chinese versions of the PedsQL™ MFS and the PedsQL 3.0 Cancer Module.

The Chinese version of the PedsQL 3.0 Cancer Module was designed to measure HRQOL, which is specific to pediatric cancer. This module consisted of 27 items and assessed 8 dimensions of HRQOL: (1) pain and hurt, (2) nausea, (3) procedural anxiety, (4) treatment anxiety, (5) worry, (6) cognitive problems, (7) perceived physical appearance, and (8) communication. The instructions and scoring method of the PedsQL 3.0 Cancer Module were identical to that of the PedsQL™ MFS, and higher scores represent a better HRQOL [14].

The intercorrelations between the total scales and subscales of the PedsQL™ MFS and the PedsQL 3.0 Cancer Module were estimated using the Pearson correlation analysis. Basing from the concept that fatigue is a disease-specific symptom that is a causal indicator of HRQOL, we hypothesized that higher scores of the PedsQL™ MFS and subscale correlate with higher scores of the PedsQL 3.0 Cancer Module (that is, less fatigue correlates with a better HRQOL). The Pearson correlation coefficients were considered accepted as medium (0.30–0.49) to large (≥0.50).

2.4.5. Concurrent validity

Concurrent validity was examined by calculating the Pearson correlation coefficient between the scores of the child self-report and parent proxy report. We hypothesized that the summary scores and the same subscales would show medium (0.30–0.49) to large (≥0.50) correlation. However, larger correlation would not mean better results because fatigue is a subjective experience; hence, a large correlation would render the child self-report and parent proxy report superfluous [14].

3. Results

3.1. Participants

A total of 125 eligible pairs of children and their parents were enrolled in our study, including 85 boys (68.0%) and 40 girls (32.0%). Most children were within 2–4 years old, and the average age (SD) was 6.41 (3.70). All of the children were diagnosed with acute leukemia, and about 99 (81.2%) of the children were receiving treatment, whereas 26 (18.8%) of the children had completed their chemotherapy.

3.2. Feasibility

The percentage of missing item responses was calculated to assess the feasibility of the PedsQL™ MFS (Chinese version). For child self- and parent proxy-reports, the percentages of missing values were 0.5% and 0.2%, respectively.

3.3. Reliability

Table 1 shows the results of the internal consistency reliability for the PedsQL™ MFS (Chinese version). The alpha coefficients of the total scales and subscales for the child self-report and parent proxy report exceeded the reliability standard of 0.70. The result demonstrated that the PedsQL™ MFS (Chinese version) had satisfactory internal consistency.

3.4. Content validity

We invited six experts who worked in pediatric nursing or psychology in Sun Yat-sen University in China to rate the CVI

Table 1 – Internal consistency reliability (Cronbach's alpha) of the PedsQL™ Multidimensional Fatigue Scale (Chinese version).

Child self-report ($n = 64$)			Parent proxy report ($n = 125$)		
Scale	Mean (SD)	α	Scale	Mean (SD)	α
Total	65.10 (16.43)	0.87	Total	58.64 (17.71)	0.93
General fatigue	63.67 (23.23)	0.85	General fatigue	53.70 (22.46)	0.92
Sleep/rest fatigue	62.57 (18.12)	0.73	Sleep/rest fatigue	57.67 (19.91)	0.85
Cognitive fatigue	69.08 (20.64)	0.83	Cognitive fatigue	64.55 (21.11)	0.91

of the PedsQL™ MFS (Chinese version) using a four-point scale from 1 to 4. The I-CVI for each item was within the scale range of 0.8–1.0, and the S-CVI values for the child self-report and parent proxy report were 0.96 and 0.99, respectively. The results indicated that the PedsQL™ MFS (Chinese version) reached the standard for content validity.

3.5. *Construct validity*

The results of the confirmatory factor analysis for the three-subscale model of the parent proxy report are shown in Table 2. The instrument had acceptable χ^2/df, CFI, NFI, and RMSEA. However, the GFI and AGFI were slightly below the cut-off value.

Table 2 – Results of confirmatory factor analysis for the three-factor model ($n = 125$)

Scale	χ^2	df	χ^2/df	GFI	CFI	NFI	AGFI	RMSEA
Parent proxy report	284.35	132	2.15	0.86	0.92	0.90	0.80	0.09

GFI, goodness-of-fit index; CFI, comparative-fit index; NFI, normed-fit index.
AGFI, adjusted GFI; RMSEA, root mean squared error of approximation.

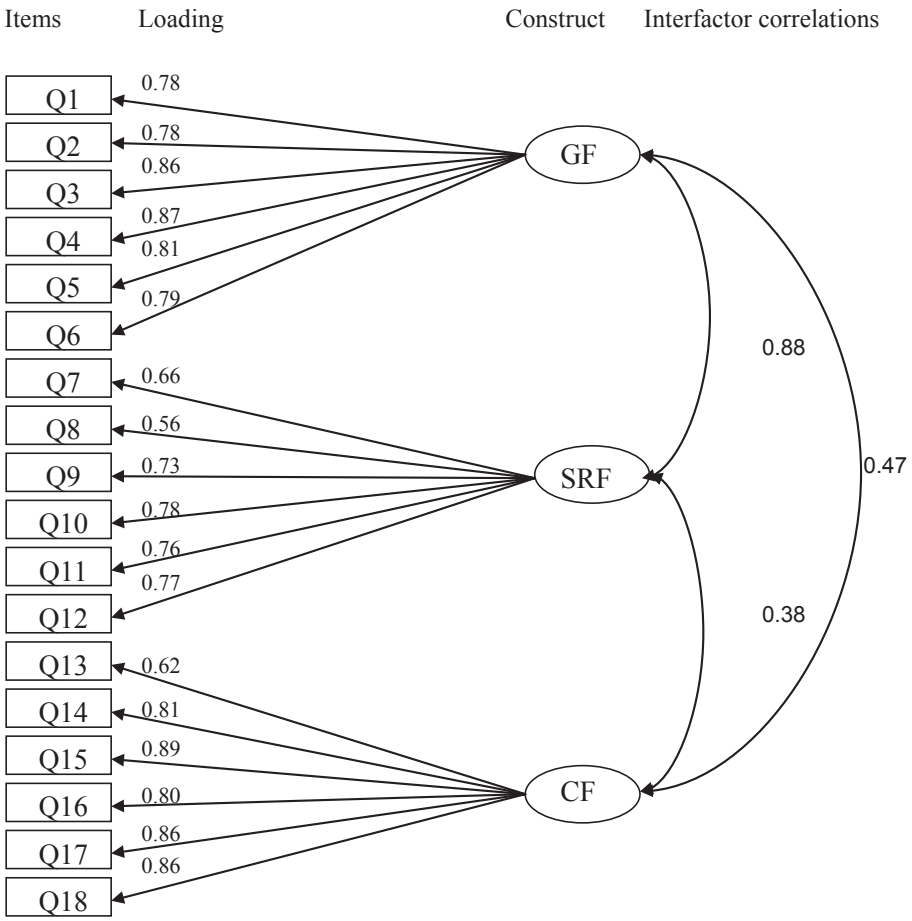

Fig. 1 – Measurement model of the PedsQL™ Multidimensional Fatigue Scale (Chinese version).

The factor loading of each item and correlations between three subscales are listed in Fig. 1. The factor loadings of items ranged within 0.78–0.87, 0.56–0.78, and 0.62–0.89 for GF, SRF, and CF, respectively. The correlation matrix displayed that all of the items in the parent proxy report were closely associated with the priori hypothesized dimensions. Therefore, the results demonstrated that the parent proxy report of the PedsQL™ MFS (Chinese version) with 18 items in three subscales achieved acceptable fit indices. Nevertheless, the result of the estimated correlation between GF and SRF was 0.88. The high correlations indicated that these two factors may not be completely separated from each other.

Table 3 – Factor loadings for the PedsQL™ Multidimensional Fatigue Scale (Chinese version).

	Factor 1	Factor 2	Factor 3
1. Feeling tired	**0.570**	0.188	0.565
2. Feeling physically weak (not strong)	**0.659**	0.157	0.458
3. Feeling too tired to do things that he/she likes to do	**0.761**	0.147	0.389
4. Feeling too tired to spend time with his/her friends	**0.782**	0.159	0.363
5. Trouble finishing things	**0.834**	0.238	0.171
6. Trouble starting things	**0.802**	0.346	0.130
7. Sleeping a lot	0.169	0.122	**0.807**
8. Difficulty sleeping through the night	**0.489**	0.215	0.312
9. Feeling tired when he/she wakes up in the morning	0.515	0.140	**0.546**
10. Resting a lot	0.297	0.123	**0.805**
11. Taking a lot of naps	0.364	0.055	**0.716**
12. Spending a lot of time in bed	**0.555**	0.112	0.533
13. Difficulty keeping his/her attention on things	0.285	**0.617**	0.140
14. Difficulty remembering what people tell him/her	0.126	**0.842**	0.082
15. Difficulty remembering what he/she just heard	0.165	**0.885**	0.047
16. Difficulty thinking quickly	0.193	**0.808**	0.137
17. Trouble remembering what he/she was just thinking	0.206	**0.846**	0.011
18. Trouble remembering more than one thing at a time	0.069	**0.868**	0.222

The results of the EFA for the PedsQL™ MFS (Chinese version) are shown in Table 3. Three factors were extracted from the EFA: Factor 1 (GF), Factor 2 (CF), and Factor 3 (SRF). Factors with an eigenvalue less than 1.0 were disregarded, and total variances explained were 68.9% variance. Two items of the parent proxy report were loaded the highest on a factor other than the priori hypothesized factor structure. Furthermore, items 8 and 12 ("Difficulty sleeping through the night," "Spending a lot of time in bed") were loaded on Factor 1 (GF), which were hypothesized to load on Factor 3 (SRF).

3.6. *Criterion-related validity*

Table 4 shows the intercorrelations between the total scale and subscales of the Chinese versions of the PedsQL™ MFS and the PedsQL 3.0 Cancer Module. Data were analyzed with Pearson correlation, and a medium (0.30–0.49) to large (≥0.50) correlation coefficient was observed between the PedsQL™ MFS (Chinese version subscales) and total scale with the PedsQL 3.0 Cancer Module (Chinese version) for both child self-report and parent proxy report as anticipated. This result indicated that a lower fatigue level correlated with better HRQOL.

3.7. *Concurrent validity*

Pearson correlation coefficients between the parent proxy report and child self-report for the PedsQL™ MFS (Chinese version) are shown in Table 5. The total scores and same subscales in the child self-reports and parent proxy-reports were within the medium to large correlation effect sizes as expected.

4. Discussion

This study presented the translation of the PedsQL™ MFS into Chinese via a strict translation/back-translation process; we also examined the psychometric properties of the PedsQL™ MFS (Chinese version) in mainland Chinese children with acute leukemia and their parents.

Table 4 – Intercorrelations between the Chinese versions of the PedsQL™ Multidimensional Fatigue Scale and the PedsQL 3.0 Cancer Module.

Scale	Parent proxy report				Child self-report			
	Total	General fatigue	Sleep/rest fatigue	Cognitive fatigue	Total	General fatigue	Sleep/rest fatigue	Cognitive fatigue
Total	0.64**	0.59**	0.48**	0.49**	0.62**	0.58**	0.46**	0.48**
Pain	0.48**	0.42**	0.34**	0.41**	0.48**	0.37**	0.40**	0.45**
Nausea	0.44**	0.38**	0.31*	0.43**	0.52**	0.43**	0.36**	0.47**
Procedural	0.41**	0.33**	0.33**	0.35**	0.57**	0.42**	0.39**	0.45**
Treatment	0.51**	0.47**	0.45**	0.33**	0.42**	0.34**	0.30*	0.35**
Worry	0.40**	0.38**	0.33**	0.35**	0.46**	0.32*	0.30*	0.41**
Cognitive	0.55**	0.34**	0.31*	0.54**	0.52**	0.41**	0.39**	0.47**
Appearance	0.38**	0.34**	0.36**	0.34**	0.50**	0.49**	0.30*	0.32*
Communication	0.47**	0.38**	0.37**	0.30*	0.44**	0.41**	0.42**	0.38**

**P < 0.01, *P < 0.05.
Procedural = procedural anxiety, *treatment* = treatment anxiety, *cognitive* = cognitive problems, *appearance* = perceived physical appearance.

Table 5 – Intercorrelations between the parent proxy report and the child self-report.

Child report	Total fatigue	Parent report		Cognitive fatigue
		General fatigue	Sleep/rest fatigue	
Total	0.50**	0.40**	0.48**	0.39**
General fatigue	0.44**	0.37**	0.42**	0.33**
Sleep/rest fatigue	0.43**	0.34**	0.58**	0.20
Cognitive fatigue	0.32**	0.24	0.16	0.38**

**$P < 0.01$, *$P < 0.05$.

The results supported that the Chinese version of the PedsQL™ MFS is a reliable and valid instrument that has a potential be used as a research and clinical instrument to measure fatigue in Chinese children with cancer.

The lack of unanswered items on the PedsQL™ MFS (Chinese version) indicated that the instrument is not unduly burdensome and that children and their parents can complete and provide accurate information. The internal consistency coefficients of the total score and subscales for both the child self-report and parent proxy report satisfied the recommended minimal standard (0.70). This result indicated that the PedsQL™ MFS (Chinese version) is a reliable instrument for the measurement of children's fatigue.

We conducted a CFA to examine the goodness of fit for the three-subscale model as reported by Varni et al. [15] through EFA. Acceptable values of χ^2/df (≤3.0), CFI and NFI (≥0.90), RMSEA (<0.10), and factor loadings (≥0.40) were calculated by CFA and proven satisfactory simulated. Nevertheless, the results of GFI and AGFI did not the criterion (≥0.90), which indicated some exceptions. In general, this result is consistent with a previous study that also evaluated the validity and reliability of the PedsQL™ MFS in Japan [10]. Therefore, the instrument should undergo further construct validation examination and improvement.

The result of EFA identified that three factors for parent proxy-reports were consistent with the original theoretical factor structure except for two items. Item 8 ("Difficulty sleeping through the night") and item 12 ("Spending a lot of time in bed") were loaded on GF instead of SRF. The results were similar to those of a previous study (10). Possibly, people tend to be easily confused with sleepiness and general fatigues.

A medium (0.30–0.49) to large (≥0.50) correlation coefficient was observed between the total scales and subscales of the PedsQL™ MFS and the PedsQL 3.0 Cancer Module, which indicated that a lower level of fatigue correlated with better HRQOL; that is, children with a lower level of fatigue had a higher level of HRQOL. These results are in consonance with previous literature that fatigue has a significant influence on children's HRQOL. Hence, healthcare workers should pay sufficient attention to the effect of fatigue on children's HRQOL.

This study demonstrated a medium (0.37–0.38) to large correlations (≥0.50) between the child self-report and parent proxy report. However, Hinds (1999) reported that parents describe fatigue differently from children who reported fatigue as increased levels of depressed mood and different physical consequences. Parent proxy-report fatigue is the diminished or complete loss of energy and a decreased ability to participate in social, academic, physical, or self-care activities at the child's usual duration or intensity level. As a subjective experience, fatigue would be more accurately recognized by children themselves. Consequently, a parent proxy report may be necessary when children are too young to complete the instrument or when they are unwilling to cooperate [15]. Basing from these findings, we suggested that referring to the parent proxy-report fatigue than to the child self-report is better when the children could not exactly understand the content in the instrument.

Previous surveys demonstrated that most children whose ages were over 3 years old can assess themselves in an age-appropriate manner [16]. Nevertheless, a number of preschool children, even a few schoolchildren in our investigation, could not respond to questions in a meaningful and reliable way. Therefore, answering all the queries in the child self-report and referring to the parent proxy report are necessary to assess fatigue in children accurately.

This study also had some limitations. First, the small sample size of child self-reports did not satisfy the minimum requirement for CFA. Thus, we evaluated only the construct validity of the parent proxy reports. Consequently, further research with a large sample size is needed. Second, we only recruited children with acute leukemia and did not include children with other malignant tumors or healthy children. Hence, the study did not compare the different levels of fatigue between heterogeneous groups.

5. Conclusions

Our newly developed PedsQL™ MFS (Chinese version) is a reliable and valid instrument for measuring fatigue in children. The instrument may be necessarily used as outcome measures in clinical practice and research, as well as a guide clinical practice, to relieve fatigue and improve HRQOL.

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